

1 **2.6 Geotechnical**

2 **2.6.1 General**

3 The Phase 1 Services scope of work in Appendix 2 (Phase 1 Services) of this
4 PDB Contract references requirements in this Section that apply to the specific
5 tasks and deliverables in the Phase 1 Services scope of work. The Design-Builder
6 shall perform all tasks that reference these Technical Requirements in accordance
7 with the requirements in this Section. The Design-Builder shall propose updates
8 to the Technical Requirements during the Phase 1 Services Period for Phase 2
9 Work necessary for each Culvert Bundle Amendment.

10 The Design-Builder shall perform all the geotechnical Work necessary to design
11 and construct the Project. Elements of the Work at a minimum, shall include the
12 following:

- 13 • The Design-Builder shall evaluate the geotechnical requirements and
14 perform all geotechnical explorations, geotechnical analyses, and laboratory
15 testing that is necessary to design and construct the Project.
- 16 • All geotechnical elements of the Project that are Released for Construction
17 (RFC) shall be fully supported with Geotechnical Recommendations,
18 supporting geotechnical data, calculations, plans, and specifications for
19 construction following the requirements set forth in this Section and the
20 WSDOT *Geotechnical Design Manual M 46-03*.
- 21 • The Design-Builder shall provide a Final Geotechnical Documentation
22 Package, as further described in this Section, that documents all the
23 geotechnical findings, Geotechnical Recommendations, calculations, and
24 design completed for the Project in accordance with this Section.
- 25 • The Design-Builder shall provide geotechnical support, review, and
26 inspection during the construction of the Project in accordance with this
27 Section.

28 **2.6.2 Mandatory Standards**

29 The following is a list of Mandatory Standards that shall be followed for all Work
30 related to this Section as referenced in TR Section 2.2, *Mandatory Standards*.

- 31 1. Standard Specifications M 41-01 (Appendix 4)
- 32 2. WSDOT *Geotechnical Design Manual M 46-03* (Appendix 4)
- 33 3. WSDOT *Bridge and Structures Office Design Memoranda* (Appendix 4)
- 34 4. WSDOT *Bridge Design Manual LRFD M 23-50* (Appendix 4)
- 35 5. WSDOT *Design Manual M 22-01* (Appendix 4)
- 36 6. WSDOT *Highway Runoff Manual M 31-16* (Appendix 4)
- 37 7. WSDOT *Materials Manual M 46-01* (Appendix 4)
- 38 8. WSDOT *Construction Manual M 41-01* (Appendix 4)

- 1 9. WSDOT *Standard Plans* M 21-01 (Appendix 4)
- 2 10. *AASHTO Guide Specifications for LRFD Seismic Bridge Design*
- 3 11. *AASHTO LRFD Bridge Design Specifications*
- 4 12. *AASHTO Manual on Subsurface Investigations*
- 5 13. *AASHTO Standard Specifications for Transportation Materials and Methods*
- 6 *of Sampling and Testing*
- 7 14. *AASHTO LRFD Specifications for Structural Supports for Highway Signs,*
- 8 *Luminaires, and Traffic Signals, 1st Edition, 2015 and all interims*
- 9 15. *FHWA Technical Manual for Design and Construction of Road Tunnels –*
- 10 *Civil Elements (Publication No. FHWA-NHI-10-034)*
- 11 16. Special Provisions (Appendix 4)

12 **2.6.2.1 Design-Build Modifications to the Geotechnical Design Manual**

13 When the WSDOT *Geotechnical Design Manual* refers to an activity that “shall”
14 be done or that “is” done, those activities are mandatory. When the WSDOT
15 *Geotechnical Design Manual* refers to an activity that “should” be done, those
16 activities are mandatory unless approved by the WSDOT Engineer. All references
17 to the Bridge and Structures Office, Geotechnical Office, Structural Designer,
18 Structural Engineer, Project Designer, Construction Project Engineer,
19 Geotechnical Engineer, Field Exploration Manager, Field Exploration Supervisor,
20 and Geotechnical Designer shall mean the Design-Builder. Where the WSDOT
21 *Geotechnical Design Manual* requires approval by the State Geotechnical
22 Engineer, the Design-Builder shall be responsible to request in writing approval
23 from the WSDOT Engineer. Work completed without the necessary approvals
24 will not be accepted.

25 No changes have been made to provisions in the WSDOT *Geotechnical Design*
26 *Manual* that do not apply to design-build contracts, (e.g., descriptions of WSDOT
27 divisions and their duties, descriptions of legal authority, or descriptions of
28 internal WSDOT procedures or policies); however, in some cases, it may not be
29 clear whether rights or responsibilities in the WSDOT *Geotechnical Design*
30 *Manual* are applicable to the Design-Builder. If it is unclear whether specific
31 provisions in the WSDOT *Geotechnical Design Manual* apply to the Design-
32 Builder, the Design-Builder shall request clarification from the WSDOT
33 Engineer. WSDOT will make that determination at its sole discretion. WSDOT
34 has identified the following provisions of the WSDOT *Geotechnical Design*
35 *Manual* that do not apply to design-build contracts:

- 36 • Section 1.2.2, Geotechnical Functions Delegated to the Regions
- 37 • Section 1.2.3, Coordination between HQ and Region Regarding
- 38 Emergency Response
- 39 • Section 1.3, Geotechnical Support within the WSDOT Project
- 40 Management Process
- 41 • Section 1.6, Geotechnical Consultant Administration

- 1 • Chapter 20, Unstable Slope Management
- 2 • Chapter 21, Material Source Investigation and Report
- 3 • Chapter 22, Geotechnical Project Development, Reports, and Support for
- 4 Design-Build Projects

5 **2.6.2.2 Subsurface Investigation Modifications to the Geotechnical Design** 6 **Manual**

7 In addition to the requirements of the WSDOT *Geotechnical Design Manual*, the
8 Design-Builder shall perform geotechnical investigations in accordance with the
9 WSDOT *Highway Runoff Manual* at locations of stormwater infiltration,
10 treatment detention ponds, wetlands, ecology embankments, Compost Amended
11 Vegetated Filter Strips (as referenced in the WSDOT *Highway Runoff Manual*),
12 infiltration ditches, and structures.

13 Where new foundations will be constructed for cantilever signals, strain poles,
14 cantilever signs, sign bridges, variable message signs, and luminaires, only a site
15 review is required if the new foundation will be entirely within new or existing
16 embankments known to be constructed of gravel borrow or select borrow and
17 compacted in accordance with Method B or C of the Standard Specifications.
18 Otherwise, subsurface conditions shall be investigated in accordance with the
19 WSDOT *Geotechnical Design Manual*. For foundations with existing
20 explorations that are more than 100 feet from the structure, new explorations shall
21 be performed.

22 WSDOT may allow the Design-Builder to waive subsurface explorations under
23 certain conditions, at WSDOT’s sole discretion. The Design-Builder shall submit
24 a memorandum stamped and signed by the Geotechnical Group Manager (GGM)
25 including the justification for the request for WSDOT’s Review and Comment.
26 For all foundations where subsurface investigations are waived, the soil
27 conditions at the foundation shall be observed during construction by the
28 Geotechnical Special Inspector. The engineer of record shall certify and document
29 in the Final Records that the observed conditions meet the design requirements. If
30 conditions are not adequate, the foundation shall be redesigned, or the soil
31 conditions shall be improved until the soils meet the design requirements.
32 Explorations shall not be waived for bridges, culverts, noise walls, or retaining
33 walls.

34 **2.6.2.3 Geotechnical Data**

35 A WSDOT Geotechnical Data Report (WSDOT GDR) has been prepared for the
36 Project and is provided as a WSDOT-Developed Reliance Document. The soil
37 conditions and groundwater levels provided in the WSDOT GDR are known only
38 at each specific boring location at the time of the boring.

1 **2.6.3 Personnel Requirements**

2 **2.6.3.1 Geotechnical Group Manager**

3 The Design-Builder shall provide a Geotechnical Group Manager (GGM) to
4 manage and review all aspects of the geotechnical design and construction Work
5 completed for the Project. The GGM shall ensure that all geotechnical Work for
6 permanent Project elements is completed in accordance with the PDB Contract
7 and Other Work Performed by Other Contractors for temporary elements is
8 coordinated and compatible with the permanent Work. The GGM shall coordinate
9 the geotechnical Work activities with the Project Quality Manager to ensure that
10 all geotechnical Work is completed in accordance with the PDB Contract, RFC
11 Documents, the Phase 1 Design Quality Management Plan (DQMP), and the
12 Phase 2 Work Quality Management Plan (QMP).

13 The GGM shall have a minimum of 10 years of supervisory experience in
14 geotechnical design and construction. The GGM shall be a Licensed Professional
15 Engineer.

16 **2.6.3.2 Design Professionals – Civil Engineers, Engineering Geologists,
17 Hydrogeologists, and Geologists**

18 All Geotechnical Recommendations, calculations, field design changes, plans, and
19 specifications shall bear the seal of the design professional responsible for the
20 Work.

21 **2.6.3.3 Peer Reviewer**

22 The Peer Reviewer shall be selected by the Design-Builder. The Design-Builder
23 shall provide a Submittal for Review and Comment to the WSDOT Engineer
24 demonstrating how the Peer Reviewer meets the required qualifications. The Peer
25 Reviewer shall be a Licensed Professional Engineer and have a minimum of 15
26 years total of design and construction experience in the areas of:

- 27 • Structural and geotechnical seismic design
- 28 • Total and effective stress Site response analysis
- 29 • Dynamic soil testing, soil liquefaction, and lateral spreading
- 30 • Seismic ground motions
- 31 • Soil structure interaction

32 **2.6.3.4 Geotechnical Field Personnel**

33 Geotechnical field personnel shall have a minimum of 2 years of experience with
34 the specific type of fieldwork they will be performing. The Design-Builder may
35 use geotechnical field personnel that does not have 2 years of experience,
36 provided that the Design-Builder trains the staff for the work that they will
37 perform prior to the performance of the Work.

1 **2.6.3.5 Instrumentation Personnel**

2 The Design-Builder’s personnel responsible for the installation and monitoring of
3 instrumentation such as inclinometers, piezometers, wells, settlement indicating
4 devices, standard penetration testing, and Becker hammer testing shall have a
5 minimum of 2 years of experience with the specific type of instrumentation they
6 will be operating unless approved by the WSDOT Engineer.

7 **2.6.3.6 Geotechnical Special Inspector**

8 The Design-Builder shall provide Geotechnical Special Inspectors (GSIs) as
9 described in this Subsection. A GSI shall have a minimum of 2 years of
10 experience of geotechnical inspection experience or be the Engineer of Record
11 (EOR) for the Project element being inspected. GSIs shall report to the GGM and
12 shall not be employed by, or be a member of a Subcontractor, crew, or individual
13 performing the Work being inspected. GSIs shall report their findings to the
14 Project Quality Manager, the GGM, and EOR.

15 **2.6.3.7 Non-Destructive Shaft Testing Personnel**

16 Personnel providing non-destructive shaft testing and reporting services shall be a
17 Licensed Professional Engineer shall have a minimum of 2 years of experience in
18 testing and interpretation of the method utilized and shall have performed similar
19 tests on a minimum of three deep foundation projects in the last 2 years.

20 **2.6.4 *Subsurface Investigation***

21 The Design-Builder shall review the available information in the WSDOT GDR
22 and perform a subsurface investigation to meet the requirements of Applicable
23 Laws, permits, and the PDB Contract.

24 **2.6.4.1 Subsurface Investigation Plan**

25 The Design-Builder shall prepare Subsurface Investigation Plan(s) (SIP). The SIP
26 shall be submitted to the WSDOT Engineer for Review and Comment prior to
27 beginning subsurface investigation Work including earthwork needed to provide
28 access for the exploration.

29 The Design-Builder may supplement the SIP at any time, provided the
30 supplements are submitted to the WSDOT Engineer for Review and Comment.

31 The Design-Builder shall determine the specific locations for explorations and
32 scope of exploration in the SIP. The Design-Builder shall secure all rights of
33 entry, permits, and environmental and archeological clearances necessary to
34 perform the Work. All subsurface investigations shall be conducted in accordance
35 with the WSDOT *Geotechnical Design Manual*, and the exploration requirements
36 identified in this PDB Contract. Field tests shall be conducted in accordance with
37 WSDOT, American Association of State Highway and Transportation Officials
38 (AASHTO), and American Society for Testing and Materials (ASTM) testing
39 procedures, in that hierarchal order.

1 Geotechnical instrumentation used for Culvert Site characterization purposes such
2 as piezometers, pore pressure transducers, and slope inclinometers shall be
3 included in the SIP, and do not need to be included in the Geotechnical
4 Instrumentation Plan (GIP).

5 **2.6.4.2 Subsurface Investigation Surveying**

6 All geotechnical borings, resource protection wells, hand holes, test pits, and cone
7 penetrometer locations shall be surveyed. All geophysical lines shall be surveyed.
8 The survey shall determine station and offset, elevation, and State plane
9 coordinates, which shall be included on the boring logs, cone penetration test
10 logs, hand hole logs, test pit logs, and geophysical data.

11 **2.6.4.3 Subsurface Investigation Samples**

12 The Design-Builder shall retain, store, and protect all soil and rock samples from
13 field explorations performed as part of the Work. These samples shall be retained
14 until Culvert Bundle Completion for each Culvert Bundle, after which time, the
15 Design-Builder shall dispose of the samples. If requested, the Design-Builder
16 shall deliver samples to the WSDOT State Materials Laboratory at 1655 S. 2nd
17 Ave. SW, Tumwater, before Culvert Bundle Completion for each Culvert Bundle
18 and the Design-Builder shall be entitled to the associated additional Culvert
19 Bundle Work Costs through a Base Guaranteed Maximum Price Adjustment.

20 **2.6.4.4 Subsurface Investigation Decommissioning**

21 Prior to Physical Completion and prior to disturbing them, all geotechnical
22 explorations shall be decommissioned, unless otherwise directed by the WSDOT
23 Engineer. The Design-Builder shall decommission all geotechnical explorations
24 completed by the Design-Builder. WSDOT will decommission all geotechnical
25 explorations shown in the WSDOT GDR. The Design-Builder is responsible for
26 contacting and coordinating with the WSDOT Engineer for decommissioning. If
27 the Design-Builder encounters an undocumented well, they shall leave it
28 undisturbed and notify the WSDOT Engineer.

29 All decommissioning shall be completed in accordance with the Mandatory
30 Standards. The Design-Builder shall provide the WSDOT Engineer with
31 Washington State Department of Ecology validated forms, including Notice of
32 Intent, well logs, and decommissioning logs, for the construction and
33 decommissioning of new wells and wells decommissioned in the course of their
34 Work. The Notice of Intent shall be submitted to the WSDOT Engineer within 30
35 Calendar Days of well construction, and the remainder of the documentation
36 referenced above within 30 Calendar Days of decommissioning the well.

37 **2.6.4.5 Subsurface Investigation Field Notes, Daily Drill Reports, Final**
38 **Boring Logs, and Final Test Pit Logs**

39 The Design-Builder shall prepare field exploration notes, inspector daily drill
40 reports, final boring logs, and final test pit logs in accordance with the WSDOT
41 *Geotechnical Design Manual* for all field exploration, geotechnical drillings, and

1 test pits. Final boring logs, final CPT logs, and final test pit logs, with a plan
2 showing their locations relative to the Work, shall be included with all Final
3 Phase 2 Design Documents and RFC Documents calculation packages and
4 Geotechnical Recommendations prepared by the Design-Builder. Draft boring
5 logs, draft CPT, and draft test pit logs shall be marked as draft and may be
6 included with preliminary Design Documents.

7 **2.6.5 Geotechnical Analysis and Documentation**

8 **2.6.5.1 Field and Laboratory Testing Requirements**

9 Field and laboratory tests shall be conducted in accordance with the WSDOT
10 *Geotechnical Design Manual*.

11 All test results shall be included in the Design-Builder's calculations, where
12 appropriate, and the Final Geotechnical Documentation Package.

13 **2.6.5.2 Geotechnical Analysis**

14 Geotechnical engineering and analyses shall be based on the findings from
15 subsurface field investigation explorations and laboratory tests performed by the
16 Design-Builder and information contained in the WSDOT GDR. All geotechnical
17 calculations using spreadsheets or math software shall be checked with hand
18 calculations to verify logic, look-ups, formulae, and calculations. Off-the-shelf,
19 commercially available, geotechnical software will not require a hand
20 calculation validation.

21 **2.6.5.3 Geotechnical Recommendations**

22 Prior to the preparation of any Geotechnical Recommendations, the Design-
23 Builder shall provide an outline or numbering system for the Geotechnical
24 Recommendations and their supporting calculation packages so that the
25 Geotechnical Recommendations can be easily cross-referenced to the supporting
26 calculation packages and incorporated into the Final Geotechnical Documentation
27 Package.

28 The Design-Builder shall provide a Final Geotechnical Documentation Package
29 including all RFC Geotechnical Recommendations and their supporting
30 calculation packages in accordance with this Section.

31 **2.6.6 Design Criteria**

32 **2.6.6.1 Seismic Design**

33 Retaining walls supporting other structures shall be designed for liquefaction
34 conditions regardless of the individual wall heights.

35 A Peer Review shall be performed if the Design-Builder implements any of the
36 following design procedures in the geotechnical seismic design:

- 37 • Site-specific hazard analysis
- 38 • Total and effective stress site-specific response analysis

- 1 • Selection of seismic ground motions used for site-specific response
- 2 • Effective stress analysis to determine the number of cycles or elapsed time
- 3 for the onset of liquefaction
- 4 • Dynamic soil structure interaction modeling for geotechnical seismic design
- 5 • Any other proposed analysis methods that are not addressed in the
- 6 Mandatory Standards or in the PDB Contract

7 The Peer Reviewer shall at a minimum review the following aspects of the
8 seismic design and analysis:

- 9 • Geotechnical data collected and reasonableness of the assumptions made by
- 10 the Design-Builder to develop the geologic and geotechnical models used in
- 11 the analyses.
- 12 • Soil and structure input parameters used by the Design-Builder in the
- 13 ground response and soil-structure interaction response analyses.
- 14 • Computer software used by the Design-Builder for ground response and
- 15 soil-structure interaction with respect to the ability of the software and
- 16 constitutive models to incorporate non-linear soil effects, pre- and post-
- 17 liquefaction stress-strain-strength relations, non-linear structure effects, and
- 18 modeling methodology.
- 19 • Interpreted results and conclusions used by the Design-Builder for design.
- 20 • Appropriate combination of seismic inertial loading, kinematic inertial
- 21 effects, and liquefied/reduced soil strength.

22 The Design-Builder shall transmit the following information to WSDOT as they
23 are developed for all Peer Reviews:

- 24 • Documents sent to the Peer Reviewer for a Peer Review
- 25 • The Peer Reviewer's comments
- 26 • Comment responses and resolution of the Peer Reviewer's comments
- 27 • Geotechnical Recommendations carrying the Peer Reviewer's Professional
- 28 Engineer's stamp and signature stating the Peer Reviewer's comments have
- 29 been resolved. The Geotechnical Recommendations shall also list the
- 30 documents, including the document date, reviewed by the Peer Reviewer

31 The Design-Builder shall be responsible for addressing all comments made by the
32 Peer Reviewer. The WSDOT Engineer shall be invited to attend all meetings
33 between the Design-Builder and the Peer Reviewer. The Peer Review comments
34 shall be resolved prior to the Geotechnical Recommendations being RFC. The
35 Geotechnical Recommendations from the Peer Reviewer shall be included as an
36 appendix in all the RFC Geotechnical Recommendations that were subject to the
37 Peer Review.

38 For structures identified as essential or critical in the PDB Contract, the
39 Geotechnical Engineer shall perform the geotechnical design necessary to support
40 two-level seismic structural design as detailed in the WSDOT *Bridge Design*
41 *Manual*, Chapter 4.

1 **2.6.6.2 Foundation Design**

2 The Design-Builder shall meet the structure foundation design and performance
3 requirements described in TR Section 2.13, *Bridges and Structures*.

4 **2.6.6.3 Retaining Wall and Noise Wall Design**

5 The Design-Builder shall be responsible for the design of walls, except for
6 WSDOT *Standard Plans* walls. The Design-Builder will not be responsible for
7 the internal design or structural design of Standard Plan walls.

8 All WSDOT Standard Plan retaining walls are designed for specific design
9 parameters, including soil strengths, ground conditions, surcharges, and geometry.
10 The parameters used are defined by the Standard Plans, WSDOT *Geotechnical*
11 *Design Manual*, WSDOT *Bridge Design Manual*, and this Section. The Standard
12 Plans should only be used if all parameters are met.

13 WSDOT Standard Plan retaining and noise walls have not been designed for
14 liquefaction or liquefaction effects. If liquefiable soils are present, the Design-
15 Build shall not use Standard Plan retaining or noise walls unless the liquefaction
16 is mitigated.

17 Policies and requirements regarding liquefaction for retaining walls are contained
18 in the WSDOT *Geotechnical Design Manual*. Liquefaction policies for noise
19 walls are not specifically addressed in detail within the WSDOT *Geotechnical*
20 *Design Manual* or WSDOT *Bridge Design Manual*. The Design-Builder shall
21 mitigate for liquefaction if liquefiable soils are present at a noise wall.

22 Noise walls contained in the Standard Plans, with two exceptions, were designed
23 following the 2007 edition of the *AASHTO Standard Specifications for Highway*
24 *Bridges* using 475-year event earthquakes with maximum peak seismic ground
25 acceleration coefficient (As) equal to 0.35 g. Current seismic design standards in
26 the *AASHTO Mandatory Standards* for 975-year events will likely result in
27 ground acceleration coefficients that exceed the 0.35 g value used for the
28 Standard Plans. Standard Plan noise walls shall not be used if the Project peak
29 seismic ground acceleration coefficient (As) exceeds the value in the Standard
30 Plans.

31 Noise walls D-2.36 (Type 11) and D-2.46 (Type 14) were designed following the
32 *AASHTO LRFD Bridge Design Specifications*, 6th Edition, 2012, and interims
33 through 2013. Accordingly, the seismic design accelerations used in the design
34 for the Type 11 and Type 14 noise walls are based on 975-year events.

35 All specially designed noise walls and retaining walls, including proprietary
36 walls, nonstandard walls, and temporary walls, shall meet the requirements in the
37 *AASHTO LRFD Bridge Design Specifications* including the provisions of the
38 current *AASHTO Guide Specifications for LRFD Seismic Bridge Design*, the
39 WSDOT *Geotechnical Design Manual*, and the WSDOT *Bridge Design Manual*.

1 **2.6.6.3.1 Structural Earth Retaining Walls**

2 If the Design-Builder selects Structural Earth (SE) Walls, they shall be pre-
3 approved proprietary walls in conformance with the WSDOT *Geotechnical*
4 *Design Manual*. If pre-approved proprietary walls as detailed in Chapter 15 and
5 the Chapter 15 appendices of the WSDOT *Geotechnical Design Manual* cannot
6 be used, specially designed SE walls may be used. Special designed proprietary
7 SE walls of the same pre-approved systems do not require special approval from
8 the WSDOT Engineer. However, if the Design-Builder wants to use wall systems
9 other than those that have been pre-approved in the WSDOT *Geotechnical Design*
10 *Manual*, the Designer-Builder shall request approval from the WSDOT Engineer.
11 The Design-Builder shall obtain approval before using a non-pre-
12 approved system.

13 SE wall manufacturer submittals shall be reviewed by the GGM for consistency
14 with the Geotechnical Recommendations for the wall.

15 **2.6.6.3.2 Nonstandard, Nonproprietary Walls and Temporary Walls**

16 The Design-Builder shall be responsible for all geotechnical and structural design
17 of nonstandard, nonproprietary noise walls; nonstandard, nonproprietary retaining
18 walls; and temporary walls including shoring and cofferdams.

19 **2.6.6.4 Slope Design and Rock Cuts (Temporary and Permanent)**

20 All temporary and permanent slopes, including reinforced slopes and rock cuts,
21 shall be designed in accordance with the WSDOT *Geotechnical Design Manual*.

22 **2.6.6.5 Foundation Design for Signals, Illumination, Cantilever Signs, Sign**
23 **Bridges, Variable Message Signs**

24 All foundations for new cantilevered signals, strain poles, cantilevered signs, sign
25 bridges, and luminaires (light standards) shall be designed in accordance with the
26 WSDOT *Geotechnical Design Manual*. The standard foundation designs provided
27 in the Standard Plans may be used if the minimum applicable soil and slope
28 conditions are present at the Culvert Site. If soil/rock or ground conditions are not
29 suitable for Standard Plan foundations, or if nonstandard loadings are present at
30 the Culvert Site, site-specific analysis and special foundation design shall be
31 completed. Design of these foundation elements shall be performed in accordance
32 with the *AASHTO Standard Specifications for Structural Supports for Highway*
33 *Signs, Luminaires, and Traffic Signals*.

34 **2.6.6.6 Ground Improvement**

35 The ground improvement or ground replacement design shall include a
36 monitoring and testing program to be implemented during construction to confirm
37 the performance of the ground improvement or to verify ground replacement
38 design parameters are achieved during construction. Differential settlement
39 between areas of improvement and areas without improvement shall be monitored
40 to confirm differential settlement tolerances are not exceeded.

1 **2.6.6.7 Settlement**

2 The Design-Builder shall evaluate and quantify primary and secondary settlement
3 for all embankments, bridge approach embankments, structures, and Utilities as
4 part of the design process. The Design-Builder shall ensure that structures,
5 WSDOT-owned lines (stormwater pipes, ITS conduit, etc.), and Utilities are
6 designed to tolerate the anticipated settlements and satisfy all settlement
7 requirements and limits contained in the Mandatory Standards and the PDB
8 Contract.

9 The following settlement criteria shall be met over the 75-year design life of the
10 Project:

- 11 • For bridge approach embankments, new embankments, and widening of
12 existing embankments:
 - 13 ○ Post-construction total settlement including both primary and
14 secondary settlement shall not exceed 4 inches.
 - 15 ○ Post-construction differential settlement including both primary
16 and secondary settlement, shall not exceed 2 inches over 100 feet
17 longitudinally.
 - 18 ○ Post-construction differential settlement including both primary
19 and secondary settlement shall not exceed 1 inch measured
20 between the centerline of the embankment and the shoulder of the
21 embankment at any given station location.
- 22 • For all new construction where transitions between different wall types,
23 different fill material, rapid changes in soil stratigraphy and/or transitions
24 from ground improvement to no ground improvement exist:
 - 25 ○ Post-construction differential settlement including both primary
26 and secondary settlement, shall not exceed 1 inch over 20 feet
27 measured longitudinally along the roadway embankment.

28 The limits required herein are to meet geotechnical design requirements. More
29 stringent settlement limits may be necessary to meet performance requirements
30 for other Project elements as required elsewhere in the PDB Contract or as
31 required by the Design-Builder.

32 **2.6.7 Construction Criteria**

33 **2.6.7.1 Performance Criteria**

34 Criteria for allowable settlement and horizontal deformation of the retaining wall
35 structures and bridge foundations are provided in TR Section 2.13, *Bridge and*
36 *Structures*, the WSDOT *Geotechnical Design Manual*, and the WSDOT *Bridge*
37 *Design Manual*. If any ground settlement occurs that is in excess of allowable
38 limits, the Design-Builder shall cease all activities in the immediate area until the
39 situation is fully assessed by the Design-Builder. The Design-Builder shall
40 immediately contact the WSDOT Engineer informing them of the situation.
41 Before the Design-Builder returns to work in the immediate area of ground
42 settlement, the Design-Builder shall implement stabilization measures to ensure
43 further settlement is minimized. The Design-Builder shall provide a submittal of

1 the ground stabilization measures with supporting calculations to the WSDOT
2 Engineer for Review and Comment. The submittal shall include an assessment of
3 the impact of the settlement on the structures and repair procedures.

4 **2.6.7.2 Slope Stability and Protection**

5 The Design-Builder shall be responsible for slope stability throughout the Project.
6 If any landslides develop during construction, or if indicators of potential
7 landslide activity appear, such as ground cracking, leaning trees, or slumping, as
8 well as other descriptors included in the referenced documents and in Chapter 13
9 of the WSDOT *Geotechnical Design Manual*, the Design-Builder shall cease all
10 activities in the immediate area within and around the unstable ground until the
11 situation is fully assessed by the Design-Builder. Before the Design-Builder
12 returns to work in the immediate area of unstable ground, the Design-Builder
13 shall implement temporary slope stabilization measures directed by the EOR to
14 ensure the safety of the public and the Design-Builder's personnel and to limit
15 damage to WSDOT facilities and adjacent properties. The Design-Builder shall
16 immediately contact the WSDOT Engineer informing them of the situation and
17 the temporary stabilization measures the Design-Builder plans to implement. The
18 design of the permanent slope stabilization shall be submitted to the WSDOT
19 Engineer for Review and Comment. The Design-Builder shall resolve all
20 comments prior to the implementation of the permanent slope stabilization
21 measures.

22 Quarry spalls shall not be used for permanent slope stabilization except for energy
23 dissipation at the end of stormwater pipes.

24 **2.6.7.3 Pre-Condition Survey**

25 Damage to structures may be caused by vibrations, embankment-induced
26 settlement, physical impact, and other construction-related activities. Before
27 construction operations that may cause damage to sensitive facilities commence,
28 the Design-Builder shall identify locations of sensitive facilities, zones of
29 influence, instrumentation types, critical readings, and frequency of readings in a
30 GIP. For buildings not owned by WSDOT, and other sensitive facilities including
31 private residences, businesses, city streets, and Utilities within the Project area,
32 the Design-Builder shall conduct a pre-condition survey. This survey shall include
33 video or photographic documentation of internal and external building walls and
34 foundations. The pre-condition survey and GIP shall be submitted to the WSDOT
35 Engineer prior to Work beginning in an affected area.

36 **2.6.7.4 Fills, Retaining Walls, and Reinforced Slopes**

37 Embankment fills, bridge approach embankments, retaining walls, and reinforced
38 soil slopes shall be monitored for settlement as required by this Section and TR
39 Section 2.13, *Bridges and Structures*. All estimates of primary consolidation
40 settlement made during the design phase shall be field verified with
41 instrumentation. The settlement monitoring data shall be provided to the GGM,
42 the EOR, and to the WSDOT Engineer for Review and Comment. The EOR shall

1 review the settlement monitoring data and provide final approval prior to the
2 placement of the final wearing course pavement located within the footprint and
3 the zone of influence of the new fills, retaining walls, and reinforced soil slopes.
4 The final approval shall be in the form of a memorandum sealed and stamped by
5 the EOR.

6 **2.6.7.5 Geotechnical Instrumentation Plan**

7 The GIP is not intended to cover geotechnical instrumentation used for Culvert
8 Site characterization work (subsurface investigation). A GIP shall be developed,
9 used, and followed when geotechnical instrumentation is required to monitor
10 structures, facilities, utilities, and other Project elements, or when Quality
11 Assurance (QA) monitoring is required. When the EOR requires instrumentation
12 and monitoring of the Work for construction purposes, the instrumentation shall
13 be included in the GIP by supplement.

14 The GIP and all supplements to the GIP shall be prepared and submitted to the
15 WSDOT Engineer for Review and Comment before deploying geotechnical
16 instrumentation. Survey points to monitor deformations shall be considered to be
17 geotechnical instrumentation. At a minimum, the Design-Builder shall install
18 geotechnical instrumentation to monitor the following:

- 19 • Sensitive facilities as identified in this Section
- 20 • Temporary shoring
- 21 • Settlement and settlement rates of embankments and structures where
22 settlements are predicted to be greater than 2 inches
- 23 • Differential settlement and settlement rates of transitions less than 20 feet in
24 length between different wall types, different fill material, rapid changes in
25 soil stratigraphy, and/or transitions to and from areas of ground
26 improvement
- 27 • Pore water pressures for staged embankment construction
- 28 • Groundwater levels, if dewatering systems are used
- 29 • Ground and structure vibrations when an impact or vibratory methods are
30 used for the installation of shaft casings or driving piling
- 31 • Vibration levels for freshly placed concrete in conformance with Section
32 6-02.3(6)D of the Standard Specifications

33 Instruments that are damaged or fail for any reason of nonperformance shall be
34 replaced immediately. If the instrumentation cannot be replaced immediately,
35 construction activities within the zone of influence that were monitored by the
36 instrumentation shall cease until the instrumentation is replaced and fully
37 operable. New instruments shall be correlated with the previously acceptable data
38 from the replaced instruments to develop continuous plots of instrumentation
39 data, but with an arrow and note indicating the date of replacement on each
40 instrument plot and data table. Instrument serial numbers and calibrations shall be
41 provided in the GIP. If serial numbers and calibrations are not available at the

1 time of GIP preparation, they shall be added to the GIP prior to being
2 implemented in the field.

3 **2.6.7.5.1 Alert Levels, Action Levels, and Corrective Action Plans**

4 The Design-Builder shall identify alert and action levels for the instrumentation
5 readings unless WSDOT has included specific alert and action levels in the PDB
6 Contract.

- 7 • Alert levels represent the reading where increased scrutiny of the element is
8 warranted and when the frequency of readings shall be increased.
- 9 • Action levels represent the reading where corrective actions shall be
10 implemented by the Design-Builder or the level where Work shall stop.
- 11 • Corrective action plans are measures that can rapidly be implemented by the
12 Design-Builder to decrease or stop detrimental stresses, strains, or
13 vibrations.

14 Alert and action levels shall be identified in the GIP for each instrument. The
15 analysis performed by the Design-Builder to determine the alert and action
16 instrumentation reading levels shall consider the allowable limits for all the
17 existing structures and Utilities in the vicinity of the proposed construction.

18 Corrective action plans shall be developed and included in the GIP. Corrective
19 action plans shall identify the steps to be taken if instrument readings reach an
20 action level. These steps at a minimum shall include the following:

- 21 • Identify where Work operations contributing to the action level shall be
22 stopped
- 23 • Notify the EOR
- 24 • Revise the Work plan
- 25 • Provide a revised Work plan to the WSDOT Engineer for Review and
26 Comment
- 27 • Require the Work that resulted in the critical instrument readings shall not
28 resume until receiving the EOR approval of the revised Work plan
- 29 • Identify circumstances where corrective actions may require modification of
30 design or construction procedures
- 31 • Require that if the approved revised Work plan does not reduce the value
32 below the critical instrument readings, all related operations contributing to
33 the critical instrument reading shall cease and the process of developing a
34 revised Work plan shall be repeated

35 If the recorded data from geotechnical instrumentation meets or exceeds the alert
36 or action levels identified, the Design-Builder shall notify the WSDOT Engineer
37 in writing within 24 hours that an alert or action level has been measured by
38 instrumentation. The Design-Builder shall notify the WSDOT Engineer in writing
39 within 24 hours of implementing the corrective action plan identified in the GIP.

1 **2.6.7.5.2** *Geotechnical Monitoring of Sensitive Facilities and Structures*

2 WSDOT has identified the following facilities and structures as being sensitive to
3 potential damage by the Work:

- 4 • Facilities: None
- 5 • Structures: See TR Section 2.13, *Bridge and Structures*

6 The Design-Builder shall prepare a GIP to monitor the facilities and structures
7 identified by WSDOT as being sensitive.

8 The Design-Builder shall also identify facilities and structures in addition to those
9 identified by WSDOT that have the potential to be damaged by the Work and
10 shall prepare a GIP to monitor those facilities.

11 **2.6.8** *Special Inspection*

12 **2.6.8.1** **General**

13 The Design-Builder shall perform special inspections and provide documentation
14 during the construction of the geotechnical types of Work listed in this Section.
15 Documentation, requirements, and the frequency of special inspections shall be in
16 accordance with the requirements of this Section and the Mandatory Standards.
17 Inspections shall be performed by a GSI unless otherwise noted herein. Special
18 inspections performed by a QA Inspection Technician shall be under the direct
19 supervision of the GSI. QA Inspection Technicians providing special inspection
20 for geotechnical works shall meet the requirements of TR Section 2.28.2.7.2,
21 *Quality Management Plan*. In addition, QA Inspection Technicians shall have a
22 minimum of 2 years of geotechnical experience with the specific type of
23 inspection they will be performing or shall be trained by the GGM or GSI to
24 perform the necessary inspections.

25 Inspection documentation prepared by a QA Inspection Technician shall be
26 submitted to the GSI. The GSI shall review the inspection documentation and
27 finalize it with the QA Inspection Technician within 1 Calendar Day. Inspection
28 documentation shall be compliant with the inspection documentation
29 requirements in TR Section 2.28, *Quality Management Plan*. All inspection
30 documentation prepared by the GSI or QA Inspection Technician, shall be
31 provided within 2 Calendar Days to the GGM, Project Quality Manager, the EOR,
32 the Construction Quality Assurance Manager (CQAM), and the Design Quality
33 Assurance Manager (DQAM). All non-conforming Work shall immediately be
34 reported in accordance with the Phase 2 Work Quality Management Plan (Phase 2
35 QMP) to the CQAM, the DQAM, the GGM, WSDOT, and the EOR.

36 **2.6.8.1.1** *Responsibilities*

37 The GSI shall review the RFC Documents and Design Documents, including
38 pertinent Geotechnical Recommendations prior to the construction activity
39 beginning. The GSI shall attend pre-construction meetings for all Work requiring
40 geotechnical special inspection. The GSI shall monitor construction, provide
41 special inspection for compliance with the Mandatory Standards, the Geotechnical

1 Special Inspection Plan (GSIP), as further described in this Section, RFC
2 Documents, and for Project elements identified in this Section. The GSI shall
3 provide the inspection and documentation duties described in this Section and TR
4 Section 2.28, *Quality Management Plan*, during the construction of geotechnical
5 features and elements in accordance with the GSIP.

6 **2.6.8.1.2 Changing Geotechnical Special Inspectors**

7 Qualified GSIs may be changed at any time prior to Work beginning on a Project
8 element, provided another qualified GSI is utilized. If a GSI must be changed
9 during a Work activity that has already started, another qualified GSI shall
10 assume the duties, provided the replacement GSI has already inspected similar
11 Work. If there is no available qualified GSI meeting the requirement above, the
12 Work for that element shall stop until a qualified GSI is available.

13 **2.6.8.2 Elements Requiring Special Inspection**

14 Temporary and permanent Project elements listed in this Section shall be
15 inspected and documented at the frequencies noted below. Additional
16 geotechnical special inspection may be required by the EOR and shall be
17 referenced in the GSIP.

18 **2.6.8.2.1 Soil Bearing Verification – Periodic Inspection**

19 For structures, materials at the bearing elevation shall be inspected to ensure that
20 the materials meet the design and construction requirements. The GSI shall
21 document observations regarding soil type, moisture conditions, and groundwater
22 conditions as encountered at the bearing elevation in the associated excavation.

23 **2.6.8.2.2 Deep Foundations, Casings, and Sheet Piles – Continuous Inspection**

24 For deep foundations such as drilled shafts, caissons, driven piles, micropiles, and
25 soldier piles, the GSI or a QA Inspection Technician shall inspect the Work to
26 ensure that acceptance criteria are achieved.

27 For driven elements, including casings installed by vibration, impact, twisting,
28 rotation, or oscillation, the GSI or a QA Inspection Technician shall observe and
29 document the installation including the methods used; equipment and
30 appurtenances used, and equipment operational parameters. The rate of
31 advancement shall be noted at a minimum every half hour and the timing and
32 duration of all stoppages shall be documented, including the reason for the
33 stoppage.

34 For drilled elements or elements constructed with grabs, chisels, down-hole
35 hammers, and other similar methods the GSI or a QA Inspection Technician shall
36 observe and document the installation including the methods used; materials and
37 ground water conditions encountered; equipment and appurtenances used;
38 equipment operational parameters; methods used to control loss of ground,
39 groundwater intrusion, heave, and caving; conditions of the bottom of a drilled
40 shaft; and penetration and tip elevation. The rate of advancement shall be noted at

1 a minimum every half hour and the timing and duration of all stoppages shall be
2 documented, including the reason for the stoppage.

3 **2.6.8.2.3 Field Testing – Continuous Inspection**

4 The following field tests shall be performed under the direction of a GSI or a QA
5 Inspection Technician:

- 6 • All verification, performance, and proof tests of soil nails (all types), ground
7 anchors (all types), pin piles, and micropiles
- 8 • Testing for pile acceptance or drivability, including Pile Driving Analyzer
9 (PDA), Pile Integrity Testing (PIT), pile load tests, and Statnamic tests
- 10 • Plate load tests

11 **2.6.8.2.4 Non-destructive Testing of Drilled Shafts – Periodic Inspection**

12 The Design-Builder shall perform crosshole sonic log (CSL) or thermal integrity
13 profiling (TIP) testing of all drilled shafts constructed for bridges in accordance
14 with the Standard Specification. The Design-Builder shall submit the results and
15 analysis of the non-destructive testing for each shaft tested to the EOR for review.
16 The EOR will determine the final acceptance of each shaft, based on the CSL/TIP
17 test results and analysis for the tested shafts. The test results and analysis and
18 determination of Final Acceptance by the EOR shall be provided to the WSDOT
19 Engineer for Review and Comment within 3 Calendar Days after receiving the
20 test results and analysis.

21 All repair of defects, including coring and schedule impacts shall be the sole
22 responsibility of the Design-Builder and shall be payable solely through the
23 Design-Builder Contingency subject to the terms and conditions of the PDB
24 Contract.

25 **2.6.8.2.5 Soldier Piles, Ground Anchors, Soil Nails, Micropiles – Continuous**
26 **Inspection**

27 The following shall be observed, verified, and documented by a GSI or a QA
28 Inspection Technician:

- 29 • Types and locations of soil/rock units encountered during construction
- 30 • Groundwater conditions during drilling; the types of equipment used to drill
- 31 • The drilling methods used, methods to remove cuttings from the hole, spoil
32 volumes, rates of advancement, and daily production rates
- 33 • Hole stability during construction and the use of casings
- 34 • Cleanliness of the bottom of drill hole
- 35 • Types, lengths, and dimensions of steel section, bars, tendons, and
36 permanent casings placed in drilled holes
- 37 • Volumes and locations of Control Density Fill (CDF), concrete, and grout
38 placed
- 39 • Caving or heave during construction

1 **2.6.8.2.6 Grouting Operations – Continuous Inspection**

2 The GSI or a QA Inspection Technician shall verify, and document compliance of
3 grout types used, mix designs, and batching/mixing equipment; and monitor and
4 record grout pressures and volumes. The report may be prepared by the GSI or a
5 representative of QA. The GSI shall review the information daily and the
6 document shall be certified as complete and accurate by the preparer.

7 **2.6.8.2.7 Ground Improvement – Continuous Inspection**

8 Ground improvement methods and performance requirements are Work-specific.
9 Accordingly, identifying geotechnical special inspection requirements shall be the
10 responsibility of the Design-Builder and referenced in the GSIP.

11 **2.6.8.2.8 Dewatering System Construction – Continuous Inspection**

12 Dewatering systems, methods, and performance requirements are Work-specific.
13 Accordingly, the GSI or a QA Inspection Technician shall observe, verify, and
14 document the following:

- 15 • Types and locations of soil/rock units encountered during the construction
16 of dewatering systems
- 17 • Groundwater conditions observed during system construction, and at the
18 completion of construction for system components
- 19 • Drilling methods used, methods to remove cuttings from drill holes, spoil
20 volumes, rates of advancement, and daily production rates
- 21 • Hole stability during construction and the use of casings and screens
- 22 • Types, lengths, and dimensions of system components installed
- 23 • Volumes and locations of the various materials placed in wells, well points,
24 and other system components
- 25 • Details of well development
- 26 • Water quantity and quality information
- 27 • Quantities and types of CDF, concrete, grout, sand, and bentonite placed
- 28 • Note all instrumentation installed and the appropriate calibration factors for
29 the equipment, if applicable
- 30 • Caving or heave during construction

31 Additional geotechnical specific inspection requirements shall be the
32 responsibility of the Design-Builder and referenced in the GSIP.

33 **2.6.8.2.9 Dewatering System Operation and Maintenance – Periodic
34 Inspection**

35 The GSI or a QA Inspection Technician shall verify and document that regular
36 maintenance is occurring and shall record observations of pumping rates and
37 discharge quantities. If groundwater monitoring is being performed, the GSI shall
38 ensure the instrumentation is being monitored and reported as required; and
39 monitor instrumentation, if required.

1 **2.6.8.2.10** *Trenchless Technology (including directional drilling, micro-*
2 *tunneling, ramming, and jacking) – Continuous Inspection*

3 Trenchless technology methods and performance requirements are Work-specific.
4 Accordingly, the GSI shall observe, verify, and document the following for
5 trenchless technology methods greater than 12 inches in diameter:

- 6 • Types and locations of soil/rock units encountered during construction
- 7 • Groundwater conditions during construction; the types, methods, and
8 operational parameters of the equipment used for construction
- 9 • Drilling methods used, methods to remove cuttings from the hole, spoil
10 volumes, rates of advancement, and daily production rates
- 11 • Hole stability during construction and the use of casings, grouts, lubricants,
12 and fillers
- 13 • Types, lengths, and dimensions of system components installed
- 14 • Quantities and types of CDF, concrete, grout, sand, and bentonite placed
- 15 • All instrumentation installed
- 16 • Appropriate calibration factors for the equipment, if applicable
- 17 • Caving, heave, or ground loss during construction
- 18 • All deviations from planned alignment, grade, and orientation

19 Additional geotechnical-specific inspection requirements shall be the
20 responsibility of the Design-Builder and referenced in the GSIP.

21 **2.6.8.2.11** *Rock Slope Cuts – Periodic Special Inspection*

22 The Design-Builder shall provide inspection and documentation of field
23 conditions during the construction of cuts in rock. Periodic special inspection for
24 this item shall be performed daily during cut construction. This documentation
25 shall include the following:

- 26 • Progress of cut construction at the time of observation
- 27 • Description and condition of soil and rock materials exposed in the cut
28 including the orientation and condition of any observed discontinuities
- 29 • Presence of and volume of seepage in the exposed cut
- 30 • Any areas of instability or potential instability
- 31 • Geotechnical Recommendations for installation of supplemental drainage
- 32 • Geotechnical Recommendations for supplemental slope stabilization
33 measures

34 All special inspection and related design services for this item shall be performed
35 by a Licensed Engineering Geologist or Geotechnical Engineer with experience in
36 the design and construction of rock cuts. The licensed professional performing
37 this inspection may be required to generate supplemental designs for drainage,
38 slope stabilization, or slope reinforcement as part of the Work. All designs shall
39 be completed in accordance with the requirements of the PDB Contract.

1

2 **2.6.9 Submittals**

3 **2.6.9.1 General**

4 All submittals, including those pertaining to changes during construction, shall be
5 submitted to the WSDOT Engineer for Review and Comment in accordance with
6 the requirements of TR Section 2.12, *Project Documentation*, and TR Section
7 2.28, *Quality Management Plan*.

8 In addition to geotechnical submittals required pursuant to Appendix 2 (Phase 1
9 Services) of PDB Contract, Project geotechnical submittals at a minimum include
10 the following (where required):

- 11 • SIP
- 12 • GIP
- 13 • GSIP
- 14 • Soil and rock properties for design
- 15 • Pre-condition survey
- 16 • Peer Reviewer qualifications
- 17 • Technical memoranda and supporting calculations
- 18 • Geotechnical report(s) and supporting calculations
- 19 • Ground stabilization measures and supporting calculation.
- 20 • Design and supporting calculations for temporary works, including shoring,
21 cofferdams, slopes, retaining walls, work access, and work platforms
- 22 • All Geotechnical Recommendations, calculations, and communications
23 issued between the Design-Builder and the Peer Reviewer
- 24 • Non-destructive test reports and determination of final acceptance by the
25 EOR
- 26 • Final Geotechnical Documentation Package

27 **2.6.9.2 Subsurface Investigation Plan**

28 The Design-Builder shall develop a SIP. The SIP at a minimum shall include
29 the following:

- 30 • A narrative of the reasons for the exploration and goals to be achieved
- 31 • A map or air photo with the proposed exploration type, location, and depth
32 shown
- 33 • Identify in-situ field tests to be performed and their frequency, including
34 Standard Penetrometer, Shelby tubes, field vane shear, suspension logging,
35 pressure meter testing, and acoustical and optical televiewer
- 36 • Instrumentation to be installed in explorations, installation procedures, and
37 monitoring schedule
- 38 • Maintenance of Traffic Plan

- 1 • Site access plans and right-of-entry permits
- 2 • Environmental considerations (spoil containment and removal) and BMP
- 3 plan
- 4 • Schedule
- 5 • Utility locates information
- 6 • Emergency procedures and contacts

7 **2.6.9.3 Geotechnical Instrumentation Plan**

8 The Design-Builder shall develop a GIP. The GIP shall identify zones of
9 influence for each instrument. The zone of influence is the three-dimensional
10 space (X, Y, and Z) to which the instrument’s readings apply.

11 The GIP shall identify instrumentation make, model, serial number, and
12 calibration documentation.

13 The GIP shall identify alert and action levels for all instruments.

14 The GIP shall contain the frequency of readings for all instruments.

15 The tolerable levels of vibration, settlement and deformation of sensitive facilities
16 shall be established as performance criteria in the GIP and the instrumentation
17 program shall provide a means of monitoring the field conditions and comparing
18 those conditions to the performance criteria established in the GIP.

19 The GIP shall include reporting requirements for all instrumentation monitoring
20 and reporting. These requirements at a minimum shall include the following:

- 21 • Frequency of monitoring (for all instruments)
- 22 • Identification of the personnel (with their qualifications) who will perform
23 the monitoring
- 24 • Frequency and schedule (elapsed time after measurement) of initial
25 instrumentation data reporting
- 26 • Format of the data in the initial instrumentation data report
- 27 • Required review of the initial instrumentation data report by the GGM
- 28 • Schedule and format of the GGM review of the initial instrumentation
29 data report
- 30 • Schedule and format of the final (and any interim) summary instrumentation
31 data report(s)
- 32 • Schedule and format of the GGM review of the final data (and any interim)
33 summary instrumentation data report(s)
- 34 • Vibration levels that if exceeded, could be potentially damaging

35 The instrumentation program shall provide a means of monitoring the field
36 conditions and comparing those conditions to the performance criteria established
37 in the GIP.

38 The GIP shall contain the requirement that all instruments shall be installed and
39 operated in conformance to the manufacturer’s requirements. The manufacturer’s

1 minimum calibration requirements for the instrumentation systems shall be
2 maintained at all times during the monitoring program.

3 The GIP shall identify critical instrument readings and threshold levels as well as
4 maximum allowable levels for all instrumentation.

5 The GIP shall contain corrective action plans.

6 **2.6.9.4 Soil and Rock Properties for Design**

7 Prior to beginning geotechnical design for the Work, the Design-Builder shall
8 submit the following items to the WSDOT Engineer for Review and Comment:

- 9 • The approach that will be used to determine the design soil and rock
10 properties for the Project (e.g., property correlations, lab test results, back-
11 analysis based on measured performance). Also, identify how variability in
12 the properties will be assessed and considered in the design.
- 13 • Soil property correlations which will be used to determine soil properties for
14 design if correlations are used.
- 15 • For a correlation not specifically cited in the WSDOT *Geotechnical Design*
16 *Manual*, supporting documentation for the correlation that provides
17 information on the development, applicability, and variation
18 of the correlation.

19 At the beginning of geotechnical design for a Project-specific element or group of
20 common elements, the Design-Builder shall define the engineering stratigraphic
21 units (ESU) to be used for the design of those elements. The Design-Builder shall
22 determine the properties for each ESU in accordance with the WSDOT
23 *Geotechnical Design Manual* and the soil and rock properties for design submittal
24 and shall utilize an over-the-shoulder review process with WSDOT to discuss the
25 properties that will be used in the design. The Design-Builder shall not modify or
26 use different properties for the final design without an over-the-shoulder review
27 of the changes. During the course of the Project, the Design-Builder may obtain
28 additional information through field exploration, laboratory testing, or back
29 analysis which could change the design properties for an ESU. Should this occur;
30 the changes to the design properties for an ESU shall be carried forward in all
31 calculation packages that postdate the change.

32 After the design is complete and RFC Documents prepared, the GGM shall
33 review calculations for temporary works during the construction phase. If the
34 GGM identifies soil or rock properties that are significantly different from those
35 used in the RFC design, the GGM shall work with the Project Quality Manager to
36 ensure that the temporary works will perform as intended and are compatible with
37 the permanent Work.

38 **2.6.9.5 Geotechnical Special Inspection Plan**

39 The Design-Builder shall develop, implement, and maintain a documented GSIP
40 intended to validate geotechnical design assumptions and requirements of the
41 Work through inspection and documentation. The GSIP shall be included in the

1 Design-Builder’s Phase 2 QMP and shall include items requiring special
2 inspection as detailed in this Section. The following shall be included in the GSIP:

- 3 • Qualifications and expertise of firms/corporations providing special
4 inspection services, including the following items:
 - 5 – A listing of firms and how they meet the minimum requirements in
6 this Section
 - 7 – List the type(s) of expertise of each firm
 - 8 – Provide an organizational chart of the proposed team and include the
9 respective roles that each firm will provide for the team.
- 10 • Qualifications and expertise of individuals providing special inspection
11 services, including the following items:
 - 12 – Individuals providing special inspection services and show how they
13 meet the minimum requirements in this Section
 - 14 – If licensed, provide the license information for the individual
- 15 • An itemized list of special inspection items or elements to be inspected
16 while performing the Work to satisfy the requirements of this Section and
17 TR Section 2.28, *Quality Management Plan*.
- 18 • Identify Hold Points in accordance with the requirements of this Section, TR
19 Section 2.28, *Quality Management Plan*, and the RFC Documents.

20 **2.6.9.6 Final Geotechnical Documentation Package**

21 The Design-Builder shall prepare a “Final Geotechnical Documentation Package”
22 that includes all final field notes, field testing, instrumentation data, laboratory
23 results, Geotechnical Recommendations, and calculation packages. The Final
24 Geotechnical Documentation Package shall be stamped and signed by a Licensed
25 Professional Engineer.

26 The Final Geotechnical Documentation Package shall be provided with all
27 supporting calculation packages cross referenced to individual sections so that it
28 can be easily determined which calculation packages apply to which section(s) or
29 design elements.

30 The Final Geotechnical Documentation Package shall be submitted for Review
31 and Comment with the Final Design Phase 2 Documents in accordance with TR
32 Section 2.12, *Project Documentation*, in electronic format (PDF).

33 **2.6.9.7 Miscellaneous Submittals**

34 At the request of the WSDOT Engineer, the Design-Builder shall deliver to the
35 WSDOT Engineer Work-related submittals that do not fit in the previous
36 categories but are prepared in accordance with this Section.

37 The GGM shall ensure that the Final Geotechnical Documentation Package is
38 delivered to the WSDOT Engineer and the WSDOT Geotechnical Office.

39 **End of Section**

